

What is claimed is:

1. A plasma etching method for etching a workpiece comprising:

5 placing the workpiece in a processing chamber defined by a reaction tube made of a dielectric material;

introducing a processing gas into the processing chamber;

10 supplying high frequency power to a high frequency antenna located outside the reaction tube, the high frequency antenna having a portion that has a relatively large capacitive coupling with the reaction tube;

generating a plasma in the processing chamber by the supplied high frequency power; and

15 moving at least one of the high frequency antenna and the reaction tube relative to the other.

2. A plasma etching apparatus comprising:

20 a reaction tube made of a dielectric material in the form of a cylinder;

a high frequency antenna located around the reaction tube for generating a plasma inside the reaction tube, the high frequency antenna having a portion that produces a relatively large capacitive coupling with the reaction tube;

25 a power supply terminal connected to a plasma source high frequency power supply;

a ground terminal connected to a ground; and

30 a drive mechanism for moving at least one of the high frequency antenna and the reaction tube relative to the other.

3. The plasma etching apparatus according to claim 2,

wherein the high frequency antenna includes a plurality of windings and a sloped segment for connecting the plurality of windings to one another.

5           4. The plasma etching apparatus according to claim 3, wherein the thickness of the sloped segment increases at locations closer to the grounding terminal.

10           5. The plasma etching apparatus according to claim 2, further comprising a rotary connector having a center shaft that is coaxial with the reaction tube, the rotary connector having an output unit rotatably supported by the center shaft and connected to the power supply terminal, the plasma source high frequency power supply being  
15 connected to the center shaft.

20           6. The plasma etching apparatus according to claim 5, wherein the center shaft is a hollow shaft, and the etching apparatus further comprises:

20           a gas introducing port in communication with the hollow shaft for introducing the processing gas from above the processing chamber; and

25           a temperature sensor cable, which passes through the hollow shaft for adjusting the temperature in the processing chamber.

30           7. The plasma etching apparatus according to claim 2, wherein a part of the high frequency antenna is located closer to the reaction tube than the remaining portion of the high frequency antenna.

8. The plasma etching apparatus according to claim 2, wherein the area of a surface of the high frequency antenna

that faces the reaction tube to be increases at locations closer to the ground terminal.

5        9. The plasma etching apparatus according to claim 2,  
wherein a part of the high frequency antenna is formed by  
twisting a plate having a uniform thickness and a uniform  
width by 90 degrees.

10       10. The plasma etching apparatus according to claim 2,  
further comprising a controller connected to the drive  
mechanism for controlling a relative moving speed between  
the high frequency antenna and the reaction tube.

15       11. A plasma processing apparatus comprising:  
a processing chamber for performing predetermined  
process on a workpiece;  
a reaction tube connected to the processing chamber,  
the reaction tube being made of a dielectric material in  
the form of a cylinder;  
20       a high frequency antenna located around the reaction  
tube for generating a plasma inside the reaction tube, the  
high frequency antenna having a portion that produces a  
relatively large capacitive coupling with the reaction  
tube;  
25       a power supply terminal connected to a plasma source  
high frequency power supply;  
a ground terminal connected to a ground; and  
a drive mechanism for moving at least one of the high  
frequency antenna and the reaction tube relative to the  
30       other.

12. The apparatus according to claim 11, further  
comprising a rotary connector having a center shaft that is

coaxial with the reaction tube, the rotary connector having an output unit rotatably supported by the center shaft and connected to the power supply terminal, the plasma source high frequency power supply being connected to the center shaft.

13. A plasma etching apparatus comprising:

an etching chamber for accommodating a workpiece;

a reaction tube connected to the etching chamber, the reaction tube being made of a dielectric material in the form of a cylinder;

a coil antenna surrounding an outer wall of the reaction tube, the coil antenna including a first winding, a second winding, and an intermediate segment connecting the first winding to the second winding;

a plasma generating power supply for supplying high frequency power to the coil antenna; and

a drive mechanism for moving at least one of the coil antenna and the reaction tube relative to the other, wherein the intermediate segment is located closer to an outer peripheral surface of the reaction tube than the first winding and the second winding.

14. The plasma etching apparatus according to claim 13, wherein the intermediate segment is inclined with respect to the first winding and the second winding.

15. The plasma etching apparatus according to claim 13, wherein the intermediate segment is thicker than the first winding and the second winding.

16. The plasma etching apparatus according to claim 13, wherein an area of the intermediate segment that faces

the reaction tube is larger than areas of the first winding and the second winding that faces the reaction tube.

5 17. The plasma etching apparatus according to claim 13, further comprising a controller connected to the drive mechanism for controlling a relative moving speed between the high frequency antenna and the reaction tube.

10 18. The plasma etching apparatus according to claim 13, wherein the drive mechanism rotates the high frequency antenna around the reaction tube.

15 19. The plasma etching apparatus according to claim 13, further comprising a rotary connector having a center shaft that is coaxial with the reaction tube, the rotary connector having an output unit rotatably supported by the center shaft and connected to the power supply terminal, the plasma source high frequency power supply being connected to the center shaft.

20 20. The plasma etching apparatus according to claim 19, wherein the center shaft is a hollow shaft, and the etching apparatus further comprises:

25 a gas introducing port in communication with the hollow shaft for introducing the processing gas from above the processing chamber; and

a temperature sensor cable, which passes through the hollow shaft for adjusting the temperature in the processing chamber.